

CLAIMS

What is claimed is:

1. A segmented flow nozzle for use with a jet engine to inhibit jet noise emitted from the jet engine, said flow nozzle comprising:
 - 5 a circumferential nozzle inner wall;
 - a circumferential nozzle outer wall spaced apart from said inner wall to define a flow path therebetween;
 - one of said inner and outer walls curving toward the other to define a protrusion, at a first region of said exhaust gas flow path, which extends into
 - 10 said flow path to reduce a cross sectional area of said flow path, thereby forming a choke flow control region;
 - said flow nozzle including a segmented region downstream of said choke flow control region; and
 - through the segmented region of the nozzle, said one wall gradually
 - 15 curving away from the other, and then back toward the other, to provide an increased cross-sectional area for un-choked flow control.
2. The nozzle of claim 1, wherein a midpoint of said segmented region defines a cross sectional area which is larger than a non-segmented
- 20 nozzle exit area.
3. The nozzle of claim 1, wherein said nozzle forms an extension of an existing nozzle structure.
- 25 4. The nozzle of claim 1, wherein:
 - a downstream edge of said segmented region comprises a cross sectional area larger than a cross sectional area at said choke flow control region.

5. A segmented exhaust nozzle for use with a jet engine to inhibit noise emitted from the jet engine, said exhaust nozzle comprising:

a first circumferential nozzle wall;

5 a second circumferential nozzle wall spaced apart from said first wall to define an exhaust gas flow path therebetween, said second circumferential nozzle wall, in cooperation with said first circumferential nozzle wall, forming a plurality of spaced apart segmented regions of the exhaust nozzle;

10 said second wall curving toward the first wall to define an arcuate protrusion that extends into said exhaust gas flow path to reduce a cross sectional area of said exhaust gas flow path and thereby provide a choke flow control region along the exhaust gas flow path;

said segmented regions being disposed downstream of said choke flow control region; and

15 said second wall gradually curving away from the first wall, and then back toward the first wall, to define regions downstream of said arcuate protrusion for providing increased cross-sectional area for un-choked flow control to said exhaust gas flowing through said exhaust gas flow path.

20 6. The exhaust nozzle of claim 5, wherein a midpoint of each of said segmented regions defines a larger cross sectional area than a downstream edge of each said segmented region.

25 7. The exhaust nozzle of claim 6, wherein said midpoint defines a larger cross sectional area than a conventional exhaust nozzle exit area.

8. The nozzle of claim 5, wherein:
an edge of said downstream region defines a nozzle exit having an effective cross sectional area approximately equal to a non-segmented
30 exhaust nozzle exit area.

9. A segmented flow nozzle for use with a jet engine flow nozzle structure, said nozzle comprising:

a nozzle inner wall;

5 a nozzle outer wall spaced apart from said nozzle inner wall;

said nozzle inner and outer walls forming said exhaust nozzle and having a nozzle throat area and a nozzle exit area downstream from said nozzle throat area;

10 at least one of said nozzle inner and outer walls curving gradually toward the other from a first point to a second point positioned downstream of said first point, relative to flow through said jet engine, to thereby reduce a cross sectional area between said nozzle walls to form an aerodynamic throat area of said segmented flow nozzle;

15 said flow nozzle including a plurality of segmented regions downstream of said throat area; and

through each said segmented region of the exhaust nozzle, said at least one of said walls then curving gradually away from the other from said second point to a third point downstream of said second point, relative to said flow through said jet engine, to thereby effectively increase the cross sectional area presented to the flow within said segmented exhaust nozzle.

25 10. The exhaust nozzle of claim 9, wherein said throat area between said first and second points represents a circumferential protrusion to accelerate said flow.

11. The flow nozzle of claim 9, wherein an intermediate point between said second and third points defines where a conventional nozzle exit point is located on a non-segmented exhaust nozzle.

30 12. The flow nozzle of claim 9, wherein through the segmented region of the flow nozzle downstream of said third point, said at least one of said walls then curving gradually toward the other from said third point to a fourth

point downstream of said third point, relative to said flow, to thereby reduce a cross sectional distance between the walls within said segmented region nozzle at said fourth point.

- 5 13. The exhaust nozzle of claim 12, wherein a region between said second and fourth points presents increased cross sectional area for subsonic flow control.

- 10 14. The flow nozzle of claim 12, wherein said cross sectional area integrated between said third point and said fourth point is effectively equal to a cross sectional area at said intermediate point.

15. A segmented exhaust nozzle for use with a jet engine fan exhaust nozzle structure, said exhaust nozzle comprising:

a fan nozzle inner wall;

5 a fan nozzle outer wall spaced apart from said fan nozzle inner wall to form an annular exhaust gas flow path;

said exhaust nozzle having a nozzle throat area and a nozzle exit area downstream from said nozzle throat area;

said outer wall curving gradually toward the inner wall from a first point
10 to a second point positioned downstream of said first point, relative to exhaust gas flow through said nozzle, to thereby reduce a nozzle throat cross sectional area of said exhaust nozzle and accelerate said exhaust gas flow therethrough;

said exhaust nozzle including a segmented region downstream of said
15 second point;

through said segmented region of the nozzle, said outer wall then curving gradually away from the inner wall from said second point to a third point downstream of said second point, relative to said exhaust gas flow, to thereby effectively increase the cross sectional area presented to said
20 exhaust gas flow within said exhaust nozzle;

wherein an intermediate point between said second and third points defines where a conventional nozzle exit point is located on a non-segmented exhaust nozzle; and

said outer wall then curving gradually toward the inner wall from said
25 third point to a fourth point downstream of said third point, relative to said exhaust gas flow; and

wherein said cross sectional area integrated through said third point and said fourth point is effectively equal to a cross section area at said intermediate point.

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16. The exhaust nozzle of claim 15, wherein a region between said first and third points defines an arcuate portion.

17. A segmented nozzle for use with a jet engine to inhibit noise emitted from the jet engine, said nozzle comprising:

a nozzle wall spaced apart from an imaginary axial center line of said nozzle;

5 said nozzle wall curving toward said imaginary axial center line to define a protrusion that extends into an exhaust gas flow path to reduce a cross sectional area of said exhaust gas flow path, thereby forming a choke flow control region;

10 said nozzle including a segmented region downstream of said choke flow control region;

through the segmented region of the nozzle, said nozzle wall gradually curving away from said imaginary axial center line, and then back toward said imaginary axial center line, to define said segmented region, which provides an increased cross-sectional area for un-choked flow control; and

15 a downstream edge of said second region defining a nozzle exit area having an effective cross sectional area approximately equal to a non-segmented exhaust nozzle exit area.

18. A segmented flow nozzle for use with a jet engine to inhibit engine noise emitted from the engine, said flow nozzle comprising:

a first nozzle wall;

5 a second nozzle wall spaced apart from said first nozzle wall to define a flow path therebetween;

one of said first and second nozzle walls curving toward the other at a first region of said flow path to reduce a cross sectional area of said flow path to thus form a choke flow control region;

10 said flow nozzle having a segmented region downstream of said choke flow control region;

through the segmented region of the flow nozzle, one of said first and second walls curving away from the other, and then back toward the other, to define said segmented region such that said segmented region has said walls
15 diverging from one another and then converging toward one another along a direction of fluid flow through said jet engine; and

a downstream edge of said segmented region defining a nozzle exit area having a cross sectional area approximately equal to a non-segmented jet engine nozzle exit area.

19. A method for inhibiting noise emitted from a jet engine, comprising:
using a nozzle inner wall and a nozzle outer wall to form a segmented
flow nozzle that provides a flow path therebetween for an exhaust flow
5 through said jet engine;

defining a first flow region within said flow nozzle having a first cross
sectional area that acts as a constriction in said flow path; and thereby forms
a choke flow control region; and

10 defining a segmented nozzle region downstream of said choke flow
control region, relative to a direction of airflow through said flow path, which
has a second cross sectional area, wherein said second cross sectional area
is larger than said first cross sectional area.

20. The method of claim 14, further comprising:

15 forming a downstream edge of said segmented nozzle region such that
a nozzle exit area thereof has an effective cross sectional area approximately
equal to that of a non-segmented nozzle exit area.

21. A flow nozzle for use with a device to inhibit noise emitted from the device as a result of a fluid flowing through the device, said flow nozzle comprising:

5 a circumferential first wall;

a circumferential second wall spaced apart from said first wall to define an annular fluid flow path therebetween;

one of said first and second walls curving toward the other to define a protrusion, at a first region of said fluid flow path, that extends into said fluid
10 flow path to reduce a cross sectional area of said fluid flow path and thus form a choke flow control region within said fluid flow path for fluid flowing through said flow path;

said flow nozzle forming a segmented region downstream of said choke flow control region; and

15 through the segmented region of the flow nozzle, said one wall curving away from the other to provide a region downstream of said choke flow control region of increased cross sectional area.

22. The flow nozzle of claim 21, further comprising:

20 said one wall curving back toward the other downstream of said region of increased cross sectional area.

23. A method for reducing noise emitted from a device having a fluid flowing therethrough, comprising:

5 disposing first and second circumferential walls adjacent one another to form a circumferential fluid flow path therebetween;

forming a protrusion on one of the walls that effectively reduces a cross sectional area of said fluid flow path to thus form a choke flow control region within said fluid flow path for fluid flowing through said flow path; and

10 downstream, relative to said fluid flow, of said choke flow control region, forming a plurality of spaced apart segmented regions forming chevron-like projections, adjacent ones of said chevron-like projections being separated by a non-segmented region of said flow nozzle; and

15 at each of said chevron-like projections, forming a region of enlarged cross sectional area between said walls, relative to said cross sectional area of said choke flow control region.

24. The method of claim 23, further forming a downstream edge of said enlarged cross sectional area region such that said downstream edge defines a cross sectional area approximately equal to a cross sectional area
20 at one of said non-segmented portions of said flow nozzle.